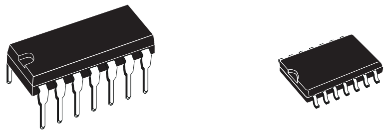
HCF4016B

QUAD BILATERAL SWITCH

- 20V DIGITAL OR ±10V PEAK TO PEAK SWITCHING
- 280Ω TYPICAL ON RESISTANCE FOR 15V OPERATION
- SWITCH ON RESISTANCE MATCHED TO WITHIN 10Ω TYP. OVER 15V SIGNAL INPUT RANGE
- HIGH ON/OFF OUTPUT VOLTAGE RATIO : 65dB TYP. at f_{IS} = 10KHz, R_L = 10KΩ
- HIGH DEGREE OF LINEARITY : < 0.5% DISTORTION TYP. at f_{IS} = 1KHz, V_{IS} = 5 V_{pp}, V_{DD} - V_{SS} ≥ 10V, RL = 10KΩ
- EXTREMELY LOW OFF SWITCH LEAKAGE RESULTING IN VERY LOW OFFSET CURRENT AND HIGH EFFECTIVE OFF RESISTANCE : 100pA TYP. at V_{DD} - V_{SS} = 18V, T_{amb} = 25°C
- EXTREMELY HIGH CONTROL INPUT IMPEDANCE (control circuit isolated from signal circuit 10^{12}Ω typ.)
- LOW CROSSTALK BETWEEN SWITCHES : 50dB Typ. at f_{IS} = 0.9MHz, R_L = 1KΩ
- MATCHED CONTROL - INPUT TO SIGNAL OUTPUT CAPACITANCE : REDUCES OUTPUT SIGNAL TRANSIENTS
- FREQUENCY RESPONSE SWITCH ON : 40MHz (Typ.)
- QUIESCENT CURRENT SPECIF. UP TO 20V
- 5V, 10V AND 15V PARAMETRIC RATINGS
- INPUT LEAKAGE CURRENT I_I = 100nA (MAX) AT V_{DD} = 18V T_A = 25°C



DIP SOP

ORDER CODES

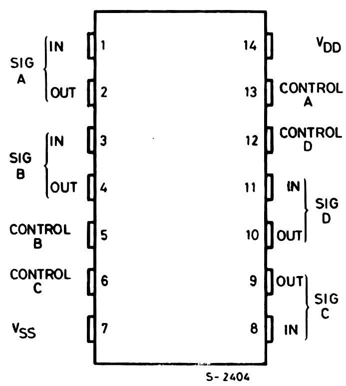
PACKAGE	TUBE	T & R
DIP	HCF4016BEY	
SOP	HCF4016BM1	HCF4016M013TR

- 100% TESTED FOR QUIESCENT CURRENT
- MEETS ALL REQUIREMENTS OF JEDEC JESD13B " STANDARD SPECIFICATIONS FOR DESCRIPTION OF B SERIES CMOS DEVICES"

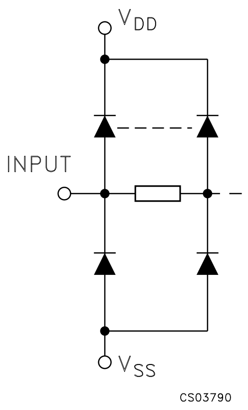
DESCRIPTION

The HCF4016B is a monolithic integrated circuit fabricated in Metal Oxide Semiconductor technology available in DIP and SOP packages.
The HCF4016B is a QUAD BILATERAL SWITCH intended for the transmission or multiplexing of analog or digital signals.
Each of the four independent bilateral switches has a single control signal input which simultaneously biases both the p and n device in a given switch ON or OFF.

PIN CONNECTION



INPUT EQUIVALENT CIRCUIT



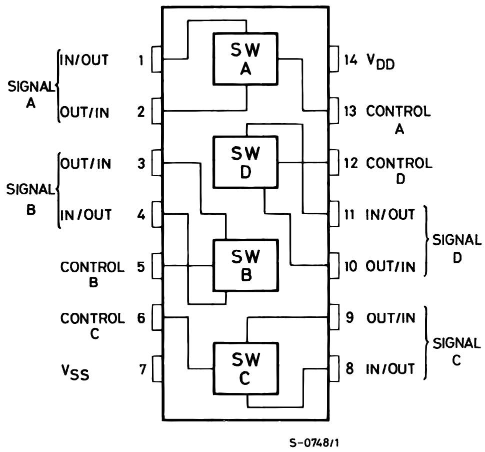
PIN DESCRIPTION

PIN No	SYMBOL	NAME AND FUNCTION
1, 4, 8, 11	A to D I/O	Independent Inputs/Outputs
2, 3, 9, 10	A to D O/I	Independent Outputs/Inputs
13, 5, 6, 12	CONTROL A to D	Enable Inputs
7	V_{SS}	Negative Supply Voltage
14	V_{DD}	Positive Supply Voltage

TRUTH TABLE

CONTROL	SWITCH FUNCTION
H	ON
L	OFF

FUNCTIONAL DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{DD}	Supply Voltage	-0.5 to +22	V
V_I	DC Input Voltage	-0.5 to V_{DD} + 0.5	V
I_I	DC Input Current	± 10	mA
P_D	Power Dissipation per Package	200	mW
	Power Dissipation per Output Transistor	100	mW
T_{op}	Operating Temperature	-55 to +125	°C
T_{stg}	Storage Temperature	-65 to +150	°C

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied.
All voltage values are referred to V_{SS} pin voltage.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Value	Unit
V_{DD}	Supply Voltage	3 to 20	V
V_I	Input Voltage	0 to V_{DD}	V
T_{op}	Operating Temperature	-55 to 125	°C

DC SPECIFICATIONS

Symbol	Parameter	Test Condition				Value							Unit
			V_C = V_{DD}	V_{SS} (V)	V_{DD} (V)	T_A = 25°C			-40 to 85°C		-55 to 125°C		
						Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
I_L	Quiescent Device Current (all switches ON or all switches OFF)				5		0.01	0.25		7.5		7.5	µA
					10		0.01	0.5		15		15	
					15		0.01	1		30		30	
					20		0.02	5		150		150	
SWITCH													
R_{ON}	Resistance	R_L = 10KΩ	+7.5	-7.5	+7.5		200	400		600		600	Ω
					-7.5		200	400		600		600	
					±0.25		280	850		1230		1230	
			+5	-5	+5		250	660		840		840	
					- 5		250	660		840		840	
					±0.25		580	2000		2380		2380	
			+15	0	+ 15		200	400		520		520	
					+0.25		200	400		520		520	
					+ 9.3		300	800		1080		1080	
			+10	0	+ 10		250	660		840		840	
					+0.25		250	660		840		840	
					+ 5.6		560	2000		2380		2380	
Δ_{ON}	Resistance Δ_{RON} (between any 2 of 4 switches)	R_L = 10KΩ	+7.5	-7.5	± 7.5		10						Ω
			+5	-5	± 5		15						
Input or Output Leakage Current Switch OFF (effective off resistance)			V_{DD} +15	V_C = V_{SS} 0			10^{-5}	± 0.3		±1		±1	µA
C_I	Input Capacitance	V_{CC} = V_{SS} = -5			+5		4						pF
C_O	Output Capacitance						4						
C_{IO}	Feedthrough						0.2						
CONTROL (V_C)													
V_{TH}	Switch Threshold Voltage	I_{IS} = 10 µA			5		2.25		1		1		V
					10		4.5		2		2		
					15		6.75		2		2		
I_I	Input Current	$V_{IS} \leq V_{DD}$			18		$\pm 10^{-5}$	±0.1		±1		±1	µA
C_I	Input Capacitance						5	7.5					pF

DYNAMIC ELECTRICAL CHARACTERISTICS (T_{amb} = 25°C, C_L = 50pF, all input square wave rise and fall time = 20 ns)

Parameter	Test Condition							Value			Unit
	V_C (V)	R_L (KΩ)	f_I (KHz)	V_I (V)	V_{SS} (V)	V_{DD} (V)		Min.	Typ.	Max.	
Propagation Delay Time (signal input to output)	= V_{DD}	10		10sq. Wave	GND	5			40	100	ns
						10			20	50	
						15			15	40	
Crosstalk Between any 2 of 4 Switches (f at -50dB) 20 log 10 $V_{O(B)}/V_{I(A)}$ = -50dB	$V_{C(A)} = V_{DD}$ = +5 $V_{C(B)} = V_{SS}$ = -5	1		$V_{I(A)}$ Δ =5p-p					0.9		MHz
Feedthrough(switch OFF) at 20 log 10 V_O/V_I = -50dB	= V_{DD} = + 5	1		5p-p		5			1.25		MHz
Frequency Response Switch"ON" (sine wave input) at 20 log 10 V_O/V_I=-3dB	= V_{SS} = - 5	1		-5p-p	-5				40		MHz
Sine Wave Distortion	= V_{DD} = 5	10	1	5p-p	-5				0.4		%
CONTROL (V_C)											
Propagation Delay Time (turn on control to output)	V_{DD} - V_{SS} (sq. wave)	1		V_{DD} or V_{SS}		5	V_{DD} - V_{SS} = 10V		35	70	ns
						10			20	40	
						15			15	30	
Max. Allowable Control Input Repetition Rate	10 (sq. wave)	1		V_{DD}	GND	10			10		MHz
Crosstalk (control Input to signal output)	10 (sq. wave)	10			GND	10			50		mV

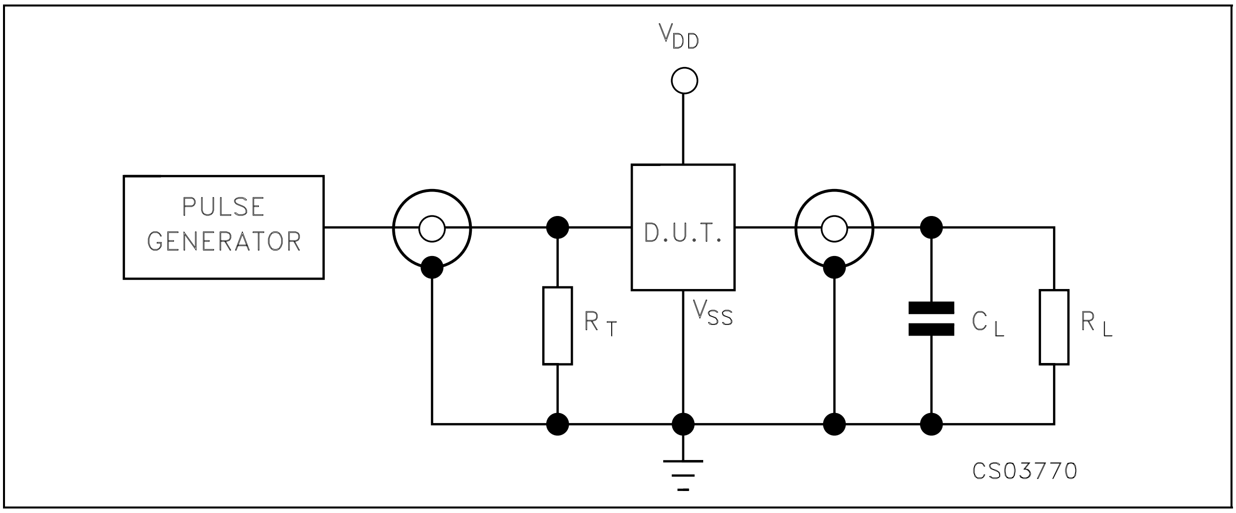
(Δ) Symmetrical about OV

TYPICAL "ON" RESISTANCE CHARACTERISTICS, T_{amb} = 25°C

Characteristics*	Supply Conditions		Load Conditions					
			RL = 1KΩ		RL = 10KΩ		RL = 100KΩ	
	V_{DD} (V)	V_{SS} (V)	Value (Ω)	V_{is} (V)	Value (Ω)	V_{is} (V)	Value (Ω)	V_{is} (V)
R_{ON}	+ 15	0	200	+ 15	200	+ 15	180	+ 15
			200	0	200	0	200	0
R_{ON} (max.)	+ 15	0	300	+ 11	300	+ 9.3	300	+ 9.2
R_{ON}	+ 10	0	290	+ 10	250	+ 10	240	+ 10
			290	0	250	0	300	0
R_{ON} (max.)	+ 10	0	500	+ 7.4	560	+ 5.6	610	+ 5.5
R_{ON}	+ 5	0	860	+ 5	470	+ 5	450	+ 5
			600	0	580	0	800	0
R_{ON} (max.)	+ 5	0	1.7K	+ 4.2	7K	+ 2.9	33K	+ 2.7
R_{ON}	+ 2.5	- 2.5	590	+ 2.5	450	+ 2.5	490	+ 2.5
			720	- 2.5	520	- 2.5	520	- 2.5
R_{ON} (max.)	+ 2.5	- 2.5	232K	± 0.25	300K	± 0.25	870K	± 0.25

* Variation from a perfect switch, R_{ON} = 0Ω

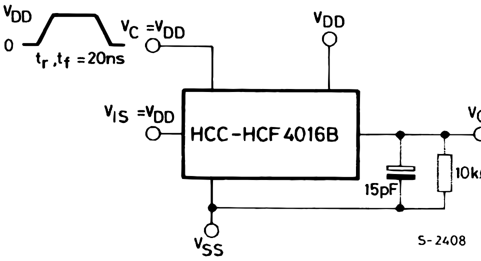
TEST CIRCUIT



C_L = 50pF or equivalent (includes jig and probe capacitance)
R_L = 200KΩ
R_T = Z_{OUT} of pulse generator (typically 50Ω)

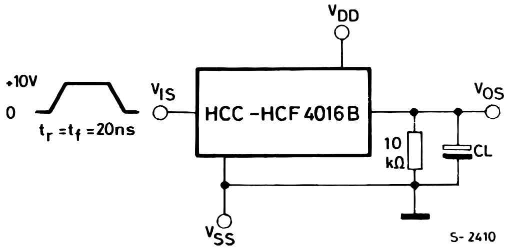
SWITCHING CARACTERISTICS TEST CIRCUIT

SQUARE-WAVE RESPONSE



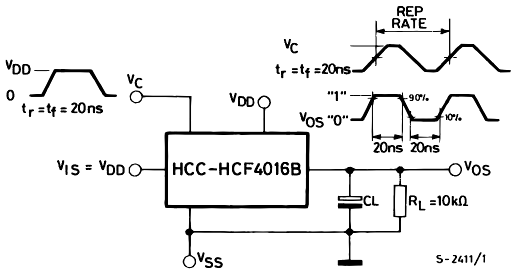
ALL UNUSED TERMINALS ARE CONNECTED TO V_{SS}

PROPAGATION DELAY TIME SIGNAL INPUT (V_{IS}) TO SIGNAL OUTPUT (V_{OS})



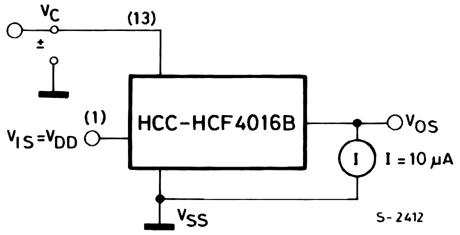
ALL UNUSED TERMINALS ARE CONNECTED TO V_{SS}

MAX ALLOWABLE CONTROL-INPUT REPETITION RATE



ALL UNUSED TERMINALS ARE CONNECTED TO V_{SS}

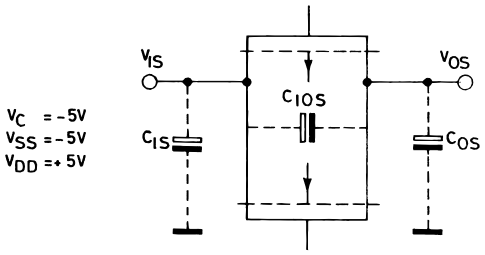
SWITCH TRESHOLD VOLTAGE



SWITCH THRESHOLD VOLTAGE IS DEFINED AS THE VOLTAGE APPLIED TO A TRANSMISSION GATE CONTROL WHICH CAUSES 10μA OF TRANSMISSION GATE CURRENT.

CAPACITANCE C_{IOS} AND C_{OS}

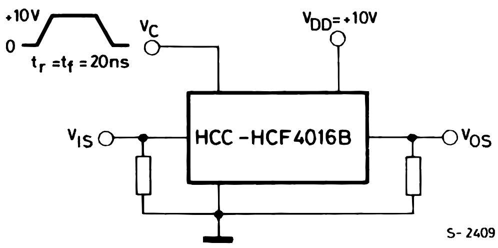
MEASURED ON BOONTON CAPACITANCE BRIDGE MODEL 75A (1MHz)



ALL UNUSED TERMINALS ARE CONNECTED TO V_{SS}

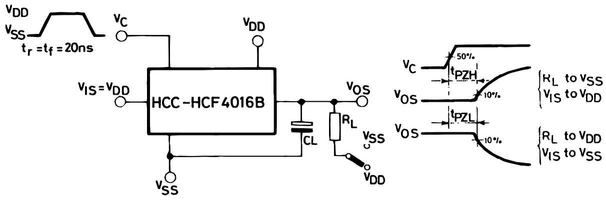
S-2413

CROSSTALK CONTROL INPUT TO SIGNAL OUTPUT



ALL UNUSED TERMINALS ARE CONNECTED TO V_{SS}

TURN-ON PROPAGATION DELAY-CONTROL INPUT TO OUTPUT

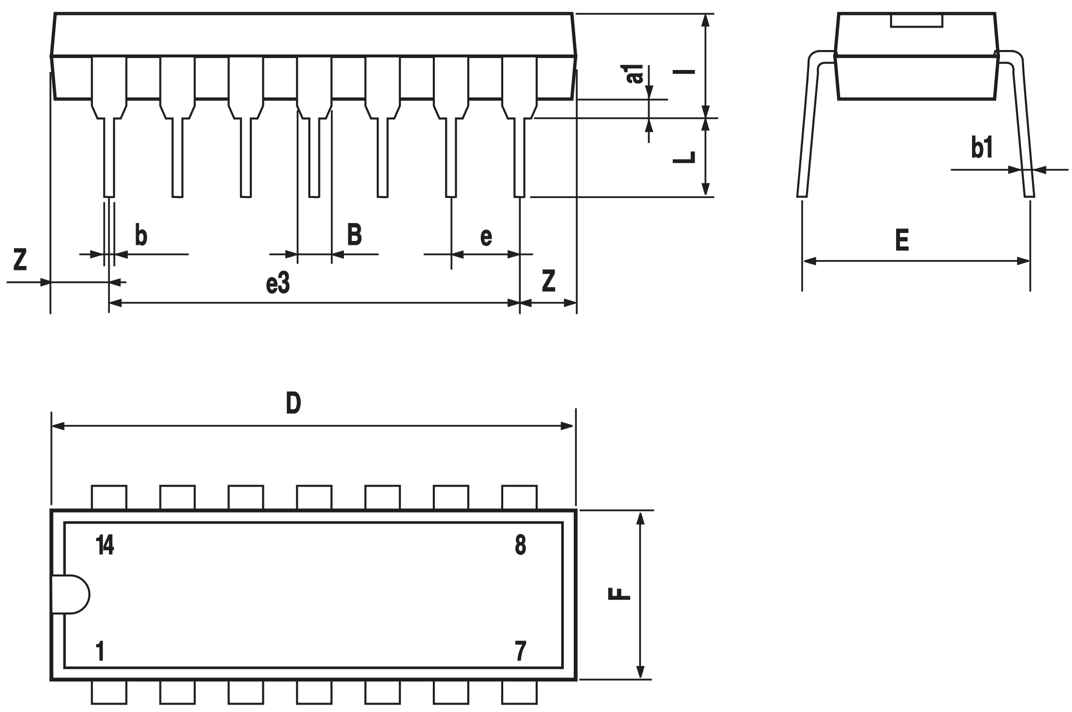


ALL UNUSED TERMINALS ARE CONNECTED TO V_{SS}

S-2414/1

Plastic DIP-14 MECHANICAL DATA

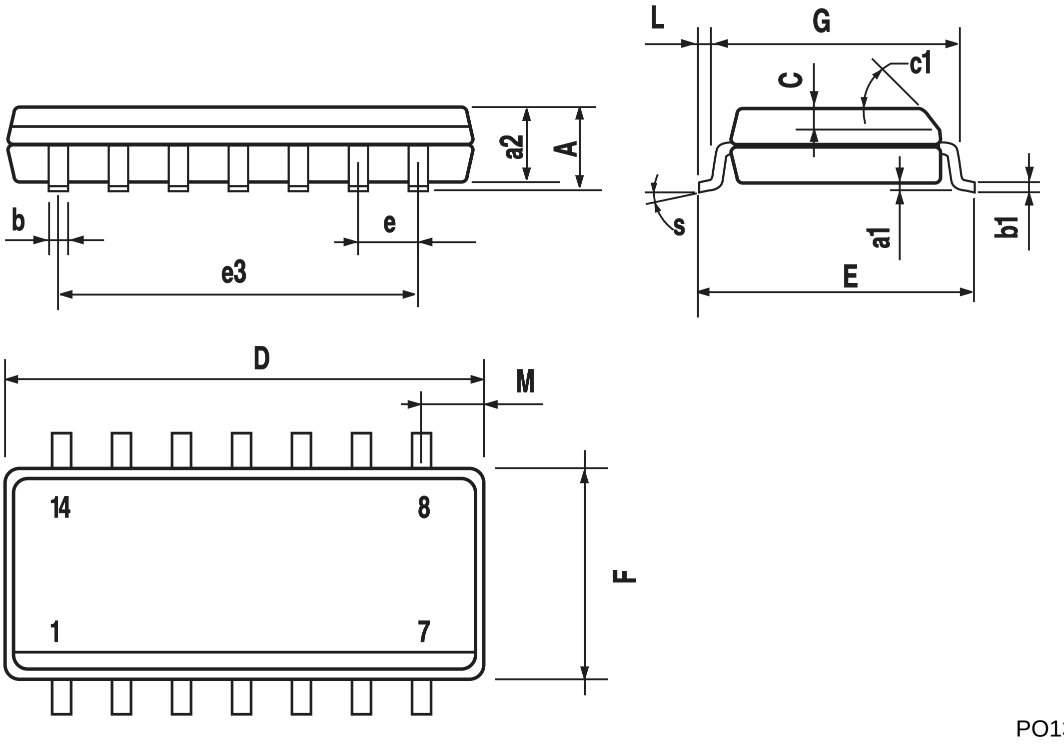
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	1.39		1.65	0.055		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		15.24			0.600	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z	1.27		2.54	0.050		0.100



P001A

SO-14 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.2	0.003		0.007
a2			1.65			0.064
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45° (typ.)					
D	8.55		8.75	0.336		0.344
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		7.62			0.300	
F	3.8		4.0	0.149		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.019		0.050
M			0.68			0.026
S	8° (max.)					



PO13G